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Mitigating the Cost of Empty Container Repositioning through the Virtual Container Yard: An Appraisal of Carriers' Perceptions

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Abstract**—**Empty container repositioning is a fundamental problem faced by the shipping industry. The virtual container yard is a novel strategy underpinning the container interchange between carriers that could substantially reduce this ever-increasing shipping cost. This paper evaluates the shipping industry perception of the virtual container yard using chi-square tests. It examines if the carriers perceive that the selected independent variables, namely culture, organization, decision, marketing, attitudes, legal, independent, complexity, and stakeholders of carriers, impact the efficiency and benefits of the virtual container yard. There are two major findings of the research. Firstly, carriers view that complexity, attitudes, and stakeholders may impact the effectiveness of container interchange and may influence the perceived benefits of the virtual container yard. Secondly, the three factors of legal, organization, and decision influence only the perceived benefits of the virtual container yard. Accordingly, the implementation of the virtual container yard will be influenced by six key factors, namely complexity, attitudes, stakeholders, legal, organization and decision. Since the virtual container yard could reduce overall shipping costs, it is vital to examine the carriers' perception of this concept.

Keywords**—**Virtual container yard, imbalance, management, inventory.

I. Introduction

THE nature of the liner shipping industry means that the supply and demand is very difficult to match [1]. Freight transportation is highly sensitive with respect to the timely delivery of cargo; thus, the availability of containers is as vital as that of ships. However, commercial cargo traffic never seems to be in balance [2]. It is rare that shipping lines have a well-balanced container inventory. The many practical reasons creating this imbalance include international trade patterns and the consequence of imbalances in the worldwide trade distribution [3], the uncertainties of customer demands, widespread allocation of container ports and customers, and the dynamic nature and increased complexity of the container shipping industry [4] and the types of commodities to be moved etc.

Container inventory management (CIM) is a highly complicated issue due to the volatility of container demand and supply. Reference [5] identifies container availability as one of the criteria that determines the service quality of ocean container carriers. The container inventory imbalance generates various costs and has a direct impact to shipping lines and their agents [6]. Shipping companies spend on average $110 billion per year in the management of their container fleets (purchase, maintenance and repairs), of which, $16 billion is for the repositioning of empties [7]. These costs include port handling costs (PHC), slot fee for the sea passage, land transport costs, ground rent and handing costs at container freight stations (CFS) etc. In addition to the direct costs, expenses related to wear and tear, and cleaning etc. are also to be considered.

According to [8], empty container movements would not exist in a perfect world, because there would always be cargo to fill every container when and where it was emptied [2]. However, shipping is not a direct demand, but a derived demand of international trade. Therefore, carriers are faced with a dilemma to strike a balance between the demand and supply [9]. Every domestic container contributes to the traffic movement on road network [10]. This is a global problem. For example, low production costs and the need for empty boxes to transport Chinese exports, made China the natural location for setting up factories for the construction of containers [11]. On the other hand, there is huge oversupply of containers in the United States due to high level of imports to the country. The empty container stocks would also occupy ground space for storage for prolonged stay, and thus creates environmental hazards. There is tremendous pressure on reducing logistics costs and the carbon footprint [12].

The concept of the virtual container yard (VCY) is based on the container interchange between carriers on a global platform. Each carrier has the virtual control of their containers globally and may release them to others only when they are not in use. The fundamental prerequisite in a VCY is that there should be a carrier who has a deficit inventory and another with excess containers. Carriers have rationalized that that a carrier's surplus containers at a particular area could be needed by another carrier which is experiencing an inventory demand in the same place [13]. This argument provides a positive incentive to the container interchange approach. However, the industry has not made a notable attempt to evaluate the benefits of container exchange because the carriers believe that there is no opportunity for container exchange, as the intrinsic trade imbalance is commonly applicable to all carriers [12]. Use of foldable containers is

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another solution to reduce the repositioning cost as these occupy lesser space when not in use. However, it does not impact on reducing the number of units that need repositioning, except the fact that the number of slots that occupy the same number of units have been reduced [14].

The core issue that prevails in the industry is to find a mechanism to decrease the cost incurred by the container inventory imbalance; thus, the better utilization of resources [15]. The absence of collaboration is mainly due to carriers' uncertainty about the feasibility of container interchange and the success of VCY mainly depends on the ability of overcoming this psychological barrier [16]. However, a firm's performance increases when supply chain members work together in cooperation [17]. The primary objective of this research is to identify the key factors that influence container interchange between carriers. Secondly, it discusses the carriers' perception about the virtual container yard. Finding a solution to mitigate the container inventory imbalance [18] would benefit primary shippers, consignees and shipping lines, and then countries, regions and entire world at the macro level. After containerization, ports were compelled to invest heavily in more efficient and effective terminals in commensurate with the speed and the attitudes the carriers demanded. Due to the nature of liner shipping industry the supply and demand is very difficult to match [15].

Cargo transportation is highly sensitive with respect to the timely delivery of the goods being shipped, as such, the availability of containers is as vital as that of ships. However, commercial traffic never seems to be in balance [2]. Very rarely will shipping lines have a well-balanced container inventory due to many practical reasons such as international trade patterns and the consequence of imbalances in the worldwide trade distribution [3], uncertainties of customer demands, widespread allocation of container ports and customers, and the dynamic nature and increased complexity of container shipping [4], as well as the type commodities to be moved etc.

II. Literature Review

Globalization has increased the need for interconnectedness [19] and it continues to hold the command in today's global community [20]. Logistics and supply chain practices are a crucial factor in the competitiveness of businesses [20] and act as important tools to achieve competitive advantage [21]. However, global supply chains are extremely varied and complex [22]. Container handling within the chain may be completed in numerous ways including the use of shipping agents [23]. Lower logistics costs are fundamental in competitive external trade. Therefore, companies focus on controlling logistics costs in order to achieve a competitive edge [24]. The mutual relationship among the carriers would improve through collaborative approach to the problem and it would help the economies of scale for the entire shipping industry. Practices act as important tools to achieve competitive advantage [21]. A case study suggests container interchange could save approximately US$ 12.6 million in Sri Lanka. Accordingly, the virtual container yard could reduce the empty reposition cost by 14% [12].

The logistics chains are assumed to be in the centre as the core part of production processes [25]. Exporters have limited patience and container shipping is a highly competitive sector. Therefore, unmet demands within a given period due to insufficient empty containers will be lost [4]. It is noted that containers are idling with many container shipping lines (CSL) thus there is a serious need for resource maximization as containers are meant for moving and not to be idled in one place. Individual shipping lines would benefit through effective and efficient management of container inventory. Generally, there is substantial cost benefit of water transport [26]. Container ships carry an estimated 52% of global seaborne trade in terms of value (World Shipping Council, 2013). If the transport cost is brought down, the price of goods and services are expected to reduce. The reduction of the cost may ultimately reflect on the consumer prices due the severe competition in liner shipping. This would help a country to bring down its inflation. Similarly, the country's exports will be more competitive in the global market due to lower transport cost. These factors would have direct impact on the welfare of a country. Striking the right balance between the exporters' demand and the carriers' ability to supply containers is the main challenge the carriers are faced with. The management of container fleets, regardless of type and size, is a rather costly operation [27]. The fundamental assumption of this paper is that the container interchange between carriers may reduce the overall cost of container inventory management.

Containerization, which changed everything, was the brainchild of Malcom McLean, an American trucking magnate [28]. This system is significant to the international trade as it holds good characteristics of sea transportation [29] and was invented and first commercially implemented in the US in the mid-1950s [30]. Container inventory imbalance (CII) is an inevitable phenomenon and that have a global impact [31] Worldwide, empty containers account for approximately 20% of container flows at sea and the costs of repositioning are about USD 400 per container [12]. The study hypothesizes that exchange of containers between carriers is a feasible solution to the problem. Providing containers help increase the utilization rate of containerships [7]. Therefore the right balances of 'container inventory' at a given location are a vital factor in liner shipping. Containers are capable of transporting efficiently over long distances and facilitate multimodal transport without intermediate reloading at any mid points [32].

Due to the perishability factor in liner shipping services, the underutilized ship space is lost forever and cannot be reused later. Usually, demands for empty containers and the arrivals of laden containers to be reused will not match [33]. Well planned, accurately forecasted, realistically allocated, and effectively managed container flows ensure that material and goods are globally supplied on time, in a cost-efficient way [34]. A decisive factor for carrier competitiveness is the availability of containers at a particular place and time to meet customer orders, avoiding immobilization costs [35]. The

expected cost of empty container reposition is subject to constraints of vessel attitudes, container demand and supply [36].

Sector collaboration in building networks can lead to the realization of synergistic gains [37]. The VCY is all about collaboration among competitors. The main purpose of the collaboration is to attain competitive advantages through achieving excellence in core business processes and expanding market share [38]. Such collaboration is evident among carriers with respect to slot sharing. However, container interchange is yet to implement although many service agreements already have provisions to interchange equipment. This may need a strategic change that can only be achieved by helping individuals reflect on and gain new insights into their situation [39]. The construction and way in which the relationships are managed create the ability to realize the potential benefits from the collaboration as increased organizational Attitudes [37]. Logistics make a major impact on economic activity in any country [40]. Better supply chain responsiveness can be achieved in two ways: by reducing uncertainties and by improving supply chain flexibility [41]. However, it is important to ensure that the costs incurred in the coalition will be fairly allocated to participating companies in the coalition [36].

III. Methodology

The study was conducted in Sri Lanka with the intention of generalizing its outcome in the global context. The researchers are confident that the results could be generalized for the benefit of the global shipping community given the maritime background in Sri Lanka. Seventeen out of top 20 CSL in the world operate regular services in the busiest commercial port in Sri Lanka's commercial and administrative capital, Colombo, due to the country's strategic geographic location. Approximately 75% of global container capacity is operated (alphaliner.com, 2014) by the said carriers. Therefore, the sample is expected to be reflective to the general view of the global shipping industry. The Ceylon Association of Ships Agents' (CASA) membership comprises 135 licensed ships' agents, representing all international shipping lines of repute. The other association, Sri Lanka Association of Vessel Operators, comprises 14 members, and 12 of them, except CSL (Ceylon Shipping Corporation) –OOCL (Orient Overseas Container Line) are members of CASA as well. The primary data collection was two folded. Accordingly, an opinion survey was conducted through 128 respondents using a questionnaire and interviews carried out with five industry specialists from the above population. With respect to secondary data, the statistics of the Sri Lanka Ports Authority, Central Bank of Sri Lanka, Sri Lanka Shippers Council, Ceylon Chamber of Commerce, Sri Lanka Apparel Exporters Association and government agencies such as Sri Lanka Customs (SLC), Sri Lanka Ports Authority (SLPA) and the Board of Investment of Sri Lanka (BOI), World Bank, and the Ceylon Association of Ships Agents have been referred.

The study administered chi-square tests to examine whether distributions of definite variables differ from one another. Basically, definite variables yield data in the groups and numerical variables yield data in numerical form. The chi square statistic associates the totals or counts of categorical answers among twp (or more) independent groups.

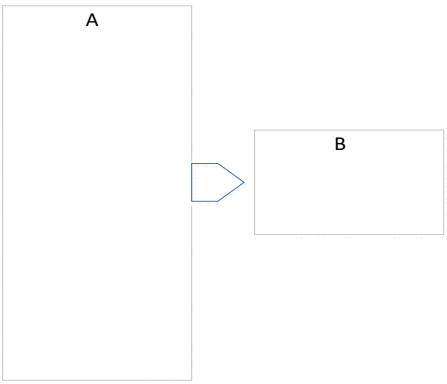

Fig. 1 Components that may influence the effectiveness and benefits of the Virtual Container Yard

The null and alternative hypothesis can be stated as follows:

$$H_0: Oi = Ei \quad (1)$$

$$H_1: Oi \neq Ei \quad (2)$$

The following equation is the statistic used to conduct this test.

$$x^2 = \sum_i \frac{(O_i - E_i)^2}{E_i} \quad \ldots \quad (3)$$

X^2 = chi – squared, O_i = Observed value, E_i = Expected value.

The questions were developed mainly based on the data gathered from interviews. The questionnaire consisted of only 18 questions. It was mainly to encourage more responses knowing the very moderate interest by the carriers. The demography section consists of seven questions based on container stock position and the company's CIM policy namely, annual empty container movement; cost associated with empty container movements; empty reposition cost as a percentage of freight earning; the frequency of inventory monitoring; characteristics of imbalance; frequency of imbalance; and whether the respondent considers container exchange as an effective solution. Finally, the questionnaire suggested if they will exchange containers on a case-by-case basis, if there is a mechanism to evaluate the overall benefit in terms of dollars. The major part of the questionnaire consisted of questions pertaining to the factors influencing the collaborative behaviour of CSL namely, culture; organization; decision; marketing; attitudes; legal; independent; complexity; and stakeholders.

A. Culture

This component considers the business culture and external

environment. Shipping is a derived demand of international trading. Therefore, CSL that operates in different organizational/business environments may have different perceptions with respect to container sharing. Accordingly, the level of employees concerning and adhering to the common legal practices and industry norms; the level of presence of international politics; the functional level of container tracking system; and the level of consideration of environment pollution due to excessive empty container movements will be tested.

B. Organization

Organizational structure, and tasks and policies are the factors consider here. Each CSL has different tasks according to the corporate objectives, vision and mission. Therefore, organizational tasks will have an impact on the perception. The supporting level for container exchange by the respondent's company vision and mission will be reviewed in the questionnaire. Another vital factor is the firm's communication channel that provides the visibility with respect to the container availability in different locations. Firstly, the right flow of information should take place within the firm covering everyone who influences the decision-making process. Secondly, this information should be strategically shared with the collaborating partners. One of the potential constraints that need to be analysed is the possible legal obligations towards antitrust law that may create barriers in sharing information between competitors. Therefore, the decision-making level of the organization (i.e. whether upper or middle) will be examined.

C. Decisions

This factor refers to decision-making level of the organization. In some CSL, local managers have the authority to take decisions with respect to containers while in some forms it needs a high authority. Employees in a hierarchical structure may perceive the sharing solution differently than in a flatter organizational structure employee. The latter is more prompt in decision making, and with shipping being an ever-changing business, those shipping companies that have such model may perceive this idea more favorably.

D. Marketing

This part refers to the organization's marketing rational of the organization and competitor tactics. According to the exploratory study, it is identified that there are firm specific practices with respect to competitors and other stake holders in this trade. Therefore, the varying business practices of the firms may influence the decision of container sharing. It was also revealed that CSL practice various competitive tactics in order to sustain and improve their individual market share. For an example, when Line A is short of containers, competitors try to grab their corporate customers providing alternative solutions. Accordingly, the perception towards sharing containers may be influenced by the competitive tactics of the firm's marketing rational. Accordingly, whether the respective company considers keeping empty containers without sharing, even at a loss to their organization as a competitive tactic, will be tested. Also, the larger CSL have resilience over container inventory, thus the attitudes of the company will be examined. CSL who have competitive edge in certain trade lanes may incorporate the empty reposition cost when they quote freight rates to pass the burden on to the customer. This factor too will be tested at the survey.

E. Attitudes

Shipping has more characteristics of a 'service' than a 'product' and therefore, the people factor plays a significant role. Taking into consideration of heterogeneity factor of a service organization, it is evident that 'people' component may act as an independent variable in this model. Therefore, whether the decision makers of respective organization have the freedom to take decisions independently will be investigated.

F. Legal

Legal implications and industry practices will be considered under this factor. Shipping is an international business, and therefore once exchanged, the carriers are under obligation to handle properties belonging to competitors under different legal regimes in many countries. This includes damages, losses, insurance, and use of containers for illegal purposes, to carry dangerous goods or dirty cargo etc. There are certain industry practices that help safeguard the interests of trade and some carriers may adhere to them while others not. Since there is no guarantee that all players in a common container pool follow such practices, carriers may be reluctant to share containers.

G. Independent

The level of freedom to take decisions independently by agents' effects container exchange. Usually, the principal carrier has strict control about the container inventory management leaving no room for the agent to take decisions even with respect to common situations.

H. Complexity

The complexity of container inventory management and control is referred to in this section. Management of container inventory is a complicated issue due to its international nature and the unpredictability of supply and demand factors.

İ. Stakeholder

The stakeholders in the container industry have variety of individual interests. Exporters want empty containers at their disposal at any given time at lowest freight and at shortest possible notice. Carriers want their import container volumes to be balanced with exports to avoid empty repositions and lean inventories at every port to optimize container utilization. The agents of carriers want agile inventories with them to cater to the exporters demand and avoid any booking cancellations due to non-availability of containers. The oligopoly nature of the shipping industry drives carriers and their agents to act independently due to marketing sensitivity. While sharing containers may relive the carrier that is in excess, it provides marketing advantages to the co sharer.

J. Effectiveness and Benefits

Finally, it was suggested that the virtual container yard is an effective container inventory management system and the carriers may interchange if they can ascertain the benefits in advance.

Respondents were required to mark their preferences in all questions fewer than eleven scales of score ranging from +5 to -5 representing highly agree to highly disagree, respectively and neutral (0). The questionnaire was made very brief and deliberately in objective form given the nature of respondents and based on previous experiences. The responses of the questionnaire survey have been analysed using descriptive statistics and regression analysis.

IV. Results and Discussions

The demography of respondents was analysed according to the range of the annual empty container movement in Sri Lanka. Most respondents were from a CSL that has an annual empty container movement of 101 to 1,000 containers

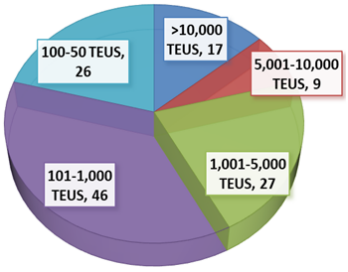

Fig. 2 Number of respondents based on empty container movements

It was inquired from the respondents as to whether they exchange containers with other carriers in an imbalanced situation. The responses were negative from all respondents. However, during the interviews with five industry experts, it was understood that containers are sometimes exchanged (just one or two) in certain ad-hoc situations where exporters stuff cargo in containers belonging to another carrier and where time is not sufficient to re-work the containers. Two of them indicated that they have experience only on one occasion where nearly 100 containers were exchanged with an alliance partner to facilitate some urgent export bookings, but it was only an isolated case that never repeated.

The respondents were asked whether the imbalance occurs 1) always, 2) often, 3) sometimes, or 4) rarely. Based on the comments, the majority (67) of 128 respondents confirmed they face the container imbalance problem often, while 36 said they always face this issue. Accordingly, 80% of respondents face the container imbalance issue either often or always. Therefore, the issue has a substantial importance to investigate and find suitable solution.

The rest of the questions were based on ascertaining the relationships with the components that were suggested in the conceptual model in the early part. Respondents were then asked whether they think container exchange an effective solution.

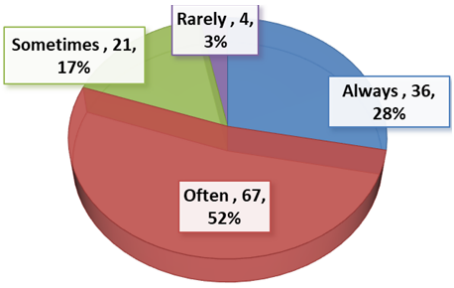

Fig. 3 Number of respondents based on the occurrence of empty container problems

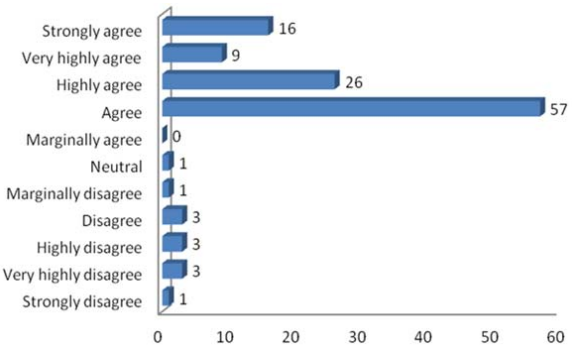

Fig. 4 Respondents' agreeability/disagreeability to the container exchange concept

It is evident from the responses that there is an overall agreement for the concept, as 48% agree and 13% strongly agree, and 8% and 22% very highly and highly agree, respectively. However, it is very important to consider the message given by 9% of the respondents; especially, the 5% of those who strongly, very highly and highly disagree to the concept.

It was very clear that the absence of a proven mechanism to find the quantified benefits of container exchange is the main obstacle in finding a solution to the problem. The respondents were asked, whether they will exchange containers if there is a mechanism to evaluate the overall financial benefits on a case-by-case basis. The responses are shown as in Fig. 5.

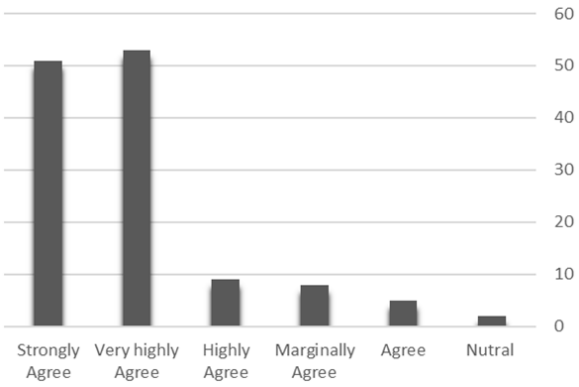

Fig. 5 Carriers' interest to exchange containers if the benefits can be assessed prior to exchange

According to this analysis, almost all respondents are willing to participate in the concept provided the benefits are assessed in monetary terms. However, it should be on a case-by-case basis as the requirements vary from time to time, location to location, and from carrier to carrier.

TABLE I
RESULTS OF CROSSTAB ANALYSIS

Dependent variable	Independent variable	Pearson Chi-Squared Value	Asymp. Sig. (2-sided)
Effectiveness	Complexity	74.104	0.004
	Stakeholders	94.657	0.001
	Attitudes	99.957	0.000
	Legal	28.355	0.814
	Organization	67.562	0.324
	Decision	51.452	0.236
	Independent	50.117	0.625
	Culture	31.910	0.664
	Marketing	74.017	0.162
Benefits	Complexity	78.777	0.000
	Stakeholders	92.184	0.000
	Attitudes	93.805	0.000
	Legal	40.853	0.004
	Organization	49.765	0.050
	Decision	47.886	0.004
	Independent	21.054	0.886
	Culture	22.426	0.318
	Marketing	35.191	0.459

The probability is <0.05 for the combination between effectiveness and complexity, stakeholders, and attitudes, as well as between benefits and complexity, stakeholders, attitudes, legal, organization level, and decision. Therefore, we could conclude that these relationships are statistically significant.

The statistical significance ($p<0.05$) between effectiveness and complexity reveals that despite that carriers consider the exchange mechanism as an effective solution, the level of complexity of container inventory control may influence their implementation to the container exchange (CE). This is quite understandable given the reality in the industry. Seventeen mega carrier alliance agreements provide provisions to container exchange. However, none of them have implemented CE as a CIM strategy of their organizations. Therefore, the need for a very user-friendly and comprehensive CE system is evident.

If this mechanism can evaluate the overall benefit in terms of dollars with respect to each CE occurrence, the carriers will be more encouraged to exchange containers. This fact is clear from the data analysis and there is a statistical significance ($p<0.001$) between benefits and complexity. Therefore, the proposed CE system should provide not only a basic container exchange management system, but a vibrant tool that provides the resultant benefits in monetary terms. Another approach may be to estimate the cost of each exchange and if the cost does not supersede the expected benefits of exchange, the carriers may willingly implement the CE concept. However, the data derived from this study does not have enough resources to evaluate these parameters. Therefore, it may need further studies to explore some methodology in order to develop a suitable model and simulate the effects of CE.

Some carriers have introduced a surcharge on empty container reposition. Accordingly, for some specific locations the exporter (or importer as the case may be) has to bear the surcharge. This action obviously creates a negative marketing impact of the agent. Incorporations of empty reposition cost to the freight rates therefore, have an impact on agents to agree to the container exchange concept. This factor is clear from the above analysis as the relationship between effectiveness and stakeholders is statistically significant ($p=0.001$) in the analysis. This is quite an encouraging observation since CE is usually neglected by the shipping agents rather than principals. This fact is clearly evidenced according to the alliance agreements mentioned above. Seventeen carriers (at principal level) accepted that CE as an effective solution. If they managed to implement this throughout the world, approximately 82% of the container traffic will have a direct impact on the CE mechanism, as these companies control 82% of global container movements. Stakeholders and financially quantified CE benefits also show a statistical significance ($p <0.001$). This factor is obvious because, the surcharge is a monetary value thus benefits of CE also need to be assessed in similar unit of measurements to compare. However, as in the previous case, this study has no sufficient data to ascertain the required values it requires further researches.

There will be a mismatch on Organizational Level Support for container exchange between the principal and their agents under these circumstances. This factor is in fact made visible in the statistical significance ($p<0.05$) between Benefits and Organization. While the agents are usually under obligations to carry out instructions given by the principal in accordance with the service contacts agreements, the common practice is that principals give high attention to the views of agents particularly in operational and marketing matters. Container inventory management has relevance to both these sensitive areas and agents always can influence the principals. As a result, it is not always the case that the wider business objectives of the principals are implemented by the agents in the same spirit. Although the exchange of containers is aligned with principals' objectives of minimizing the overall cost of operations worldwide, the sales problems that can be expected at the agent's level also create a serious impediment. The organizational level impact does not end there. The decision-making level of the organization (of both principal and agent) is a barrier in implementation. Usually, the upper level management of the principal will be in favor of the container exchange mechanism because of its important level of economic benefits. However, the liner managers that really drive the operational activities, such as container management in the ground level situation, find it as an additional burden on their job. In particular, marketing staff at the middle level will paint a very negative picture at the management level considering this as a threat to the organization. This may not be the case with the agents' office though. The psychology will be generally reversed in this situation. While the ground level managers in the operations department may find it

logical to share with their industry colleagues as they can effectively assist the customers providing empty containers in disastrous shortage. The statistical significance ($p<0.05$) provides evidence of these views.

Attitudes of container inventory of the company also have an impact on container exchange, although carriers have identified CE as a solution to the CIM problem. This has a direct relationship with respect to evaluating the overall benefits of CE in monetary terms. The statistical significance ($p<0.001$) of effectiveness vs. the volume of container inventory, and the benefits vs. attitudes is evident in the analysis. It also has some relevance to the complication that was earlier explained under the complexity section. The greater the size of the inventory, the more complex it becomes, particularly with objects that are circulated all over the world. Carriers usually find it difficult to manage their own stocks as it covers the global supply chain and tracking is a serious matter. Not only carriers, but even agents sometimes deploy many container controllers in their organizations for this purpose.

The container exchange, irrespective of its very visible advantages, may generate some complications particularly in terms of legal parameters. Usually a carrier has three sources of empty containers that are used for their export bookings. They are: 1) the carrier-owned containers (COC), 2) on-hire or leased containers, and 3) shipper-owned containers (SOC). Therefore, at a given time carriers may have containers of all these categories dispersed globally, in sailing ships, in the hands of exporters, importers, container yards, port terminals, customs warehouses, on the roads on trucks, on rails or simply abandoned with a third party due to some issues. Therefore, monitoring the container inventory is a serious activity of a carrier. With the introduction of alliance agreements between carriers and commencement of slot sharing activities, this situation was further complicated. Now that the containers are commonly in the alliance vessels, this has created a situation that carriers have to handle their competitors' containers in addition to their own. Similarly, carriers have to release their containers into the hands of competitors according to the alliance agreements. Initially, this created many marketing disadvantages to carriers as their highly sensitive customer data lost its security. But given the economies of scale advantage that supersedes these barriers, it paved the way for successful collaboration among carriers for slot exchange. The possible legal implication that will aggravate with container exchange should be explained with this background. After successful implementation of a CE system there can be a possibility of an export cargo belonging to exporter E, stuffed into a container belonging to carrier C, freight handled by forwarder F, loaded on board a ship owned/chartered by carrier S, stacked in a slot owned by carrier A. Therefore, in an event of a legal implication, the number of parties that will be involved is getting higher and higher. However, one can also argue that this complication is already in existence even now. If the C is replaced by a leasing company which is in existence does not make any difference. Therefore, the critical factor that needs to be considered here is that a similar or even stronger legal documentation should be in place for effective implementation of the CE model. The statistical significance ($p<0.05$) reflects that there is a relationship between benefits, and complying with the legal procedures will be an additional burden to exchange containers.

V. Conclusions and Recommendations

The industry players perceive that the complexity, stakeholders, and attitudes may influence both effectiveness and benefits of VCY. However, legal, organization, and decision may influence only one component namely, benefits. Factors such as independent, culture, and marketing do not show any statistically significant relationship with either effectiveness or benefits. The study reveals that container exchange has a potential in solving the container imbalance issue. However, the industry does not show a unanimous agreement to the concept. The comments received during the interviews reveals that the carriers are not highly influenced with the concept mainly because of branding issues. And the industry has no literature that gives scientific analysis of the solution. In other words, the industry hypothetically believe that if a country has a trade imbalance (i.e. the variation between imports and exports), the container imbalance is something inevitable. When this is true, it applies to any shipping line serving in that country or port. This makes sense as there should be two parties namely, one is deficit and other is excess in order to originate an 'exchange'.

This myopic view of the industry is in fact discouraging the carriers to explore the possibilities in finding a solution through container exchange. Therefore, it should be proved to the industry with the use of real industry data with respect to the opportunities available. In other words, the number of carriers that need empty containers (offeree) and those who can provide containers to them (offeror) at a given time and at a given location should be highlighted. This factor has some relevance to the queuing theory as well. For example, the industry gauges the seriousness of the container imbalance simply calculating the stock levels at the beginning and the end of the year. However, there are more activities taking place during the year when considering the monthly or weekly imbalances. Therefore, a case study to investigate the realistic movement on a monthly bases (or weekly basis provided the data accessibility) by each carrier should be recommended. This may need a theoretical modeling of collaboration among shipping lines with respect to container sharing and proposing a unit of measurement to quantify the outcome of container exchange.

It would be necessary to identify and evaluate the existing solutions to mitigate the container inventory imbalance problem prior finding a new solution. It is then obviously necessary to identify the factors that influence the existing practices. As the outcome of such study, it would be worthwhile to develop an operating model that incorporates existing CIM strategies and practices of CSL. In terms of generalizing the results with other countries, it may be important to explore a mechanism that could evaluate a particular country's competence in CIM. If the competence is

low, the respective country needs more efforts in rectifying their short comings in order to improve their index. Accordingly, development of a global CIM competence index would be useful

Once the groundwork for an effective CIM mechanism is constructed, the study may require exploring the container exchange possibilities based on real data. It may also explore any other potential solutions to the container inventory imbalance problem in contrast to the container exchange mechanism. After such unbiased evaluation, the study may further explore the efforts of minimizing the container inventory imbalance through collaboration among carriers.

The most significant factor in the whole study is that container exchange has not been effective despite the fact that carriers in principle agree with the concept. It may be due to some peculiarity with regard to the organizational behavior of carriers. Therefore, further discussion on container exchange between CSL would be vital to understand the behavioral aspects that lead to the absence of collaboration. This should be followed by development of a container exchange simulation model and introduction of a virtual container pool.

In order to attract carriers to the container exchange concept, evaluating the potential benefits and pitfalls of container exchange between CSL should be required. This may be done as case study in Sri Lanka. Further research may be required with respect to optimization of container utilization through minimizing empty container repositioning and evaluate the degree of opinion on the collaboration among shipping lines to view the industry point of view. The container exchange simulation model may be validated using the views of industry experts in view of further research and development of an online software application to facilitate implementation and the sustainability of the new concept is recommended.

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